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Psychophysical effects of subtle modification of the built environment: a quasi-experimental field study

Rich Masters, Catherine Capio, Thomson Wong, Jamie Poolton, Liis Uiga

University of Waikato, Hamilton, New Zealand (Prof R Masters DPhil)**;**
University of Hong Kong, Hong Kong, China (Prof R Masters, C Capio PhD, J Poolton PhD, T Wong PhD, L Uiga MSc)**; and Leeds Beckett University, Leeds, UK** (J Poolton)

Correspondence to: Professor Rich Masters, Te Oranga School of Human Development and Movement Studies, University of Waikato, Hamilton 3232, New Zealand
rmasters@waikato.ac.nz

Abstract

Background
China's rapid urban growth is associated with an increasingly unhealthy population. Urban planners can design cities to promote healthy lifestyles, but to re-engineer the existing built environment is no simple task. We assessed whether a simple modification of the built environment was associated with altered perceptions of, and ambulation in, that environment.

Methods
We adjusted a single-rail stair banister (length 3 m, height 1 m) in an urban area of Hong Kong, China, to increase or decrease the convergence angle with the stairs by 10% (plus or minus 1.91°). When positioned conventionally, the banister was parallel to the stairs (2.19 m width, 26.5° incline). 92 participants (mean age 19.71 [0.79], 54 male and 38 female) who were unaware that the banister diverged from (n=32), converged with (n=30), or was parallel to the stairs (n=30), visually estimated the angle of incline of the stairs from the top by rotating a disk to match the slant of the staircase. Walking speed (metres per second) was video-recorded surreptitiously as a sub-sample of the participants (n=36) approached the stairs with the banister in each position. Data were analysed using one-way analysis of variance followed by Bonferroni comparisons. Ethical approval of the study was obtained from the University of Hong Kong Research Ethics Committee, and participants provided written informed consent to participate.

Findings
Visual estimations differed between the groups ($F_{2,89}$=6.62, p=0.002, η^2=0.13); estimates of angle were smaller when the banister converged with the stairs (32.53 [8.39]°) than when it diverged (39.69 [9.50]°) (p=0.007) or was parallel (39.88 [8.92]°) (p=0.006). Walking speeds in the final three strides preceding transition to stair descent also differed ($F_{2,70}$=3.11, p=0.05, η_p^2=0.08) with mean walking speed slower when the banister diverged (1.24 [0.26] m/s) than when it converged (1.36 [0.19] m/s) (p=0.046).

Interpretation
Modification of the angle of a stair banister was associated with differences in perception of the steepness of stairs and in walking behavior during approach to the stairs. Problems associated with rapid urban development, including falls in older people and physical inactivity, are high on the health agenda of the Chinese government. Future work should examine whether stairs that appear less steep are more readily climbed, thus promoting physical activity, and whether stepping parameters are improved, thus promoting fewer falls.

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Contributors
RM conceived the idea, designed the experiment, and wrote the manuscript. LU, CC, JP, and TW conducted the experiment, contributed to the design of the experiment, and edited the manuscript. RM, CC, and LU analysed the data. All authors have seen and approved the final version of the abstract for publication.

Declaration of interests
We declare no competing interests.